Original Article

Pattern of co-infection by enteric pathogenic parasites among HIV sero-positive individuals in a Tertiary Care Hospital, Mumbai, India

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Abstract

Introduction: One of the major medical concerns in people living with HIV/AIDS (PLHA) is management of diarrhea that can lead to severe morbidity and mortality. Such clinical scenario warrants an analysis of intestinal parasites, which are important opportunistic pathogens in PLHA. Owing to the scarcity of recent pattern of intestinal opportunistic infections from this region, the study was designed to determine the opportunistic parasites causing diarrhea in PLHA; and to find out whether there is any significant difference in the enteric parasitic pathogens in patients with different immunological status and in those on highly active anti retro-viral therapy (HAART). **Materials and Methods:** Analysis of the spectrum of intestinal parasites was carried out with 192 subjects in two groups (142 HIV sero-positive patients having diarrhea and 50 HIV sero-negative patients having diarrhea). The routine light microscopic examination was carried out to determine the infection and CD4+ T-Lymphocyte count was estimated using flow cytometry. **Results:** Enteric parasites were detected in 35.9% of HIV sero-positive patients having diarrhea and 18% of HIV sero-negative patients having diarrhea. Most common opportunistic enteric parasite was *Isospora belli* (11.5%); others were *Entamoeba histolytica* (4.7%), *Cryptosporidium* sp. (3.6%), *Strongyloides stercoralis* (3.1%), *Giardia intestinalis* (3.1%) and *Cyclospora cayatanensis* (1.6%). Opportunistic enteric parasites were detected in significantly low numbers in patients with CD4+ T-Lymphocyte counts >500 cells/ml; and in those taking HAART.

Key words: CD4+ T-Lymphocyte counts, highly active anti retro-viral therapy, opportunistic parasites, people living with HIV/AIDS

INTRODUCTION

The most common co-infection in HIV-infected individuals after tuberculosis is infective diarrhea, developing in around 30–90% of cases. Since the onset of AIDS, incidence of diarrhea has increased in countries such as India, Nepal, Bangladesh, and South East Asian countries; of which parasitic diarrheas comprise a significant percentage.[1,2] Parasitic diarrheas cause noteworthy morbidity and mortality. However, after identification many of them are treatable; thus early diagnosis and timely treatment is crucial and plays a momentous role in improving quality of life of people living with HIV/AIDS (PLHA).

Since infection by intestinal parasites has an essential role in clinical condition of PLHA and recent reports focusing on opportunistic infections (OIs) causing diarrhea in PLHA are limited

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from this region, the main aim of the study was to identify the current type and frequency of the enteric parasites in HIV sero-positive/AIDS patients; and also to co-relate the incidence with highly active anti retro-viral therapy (HAART) and immunological status of the patient.

Study design

The study was conducted from February-2006 to April-2008, in Grant Medical College and Sir JJ Group of Hospitals; a 1350 bedded tertiary care hospital at Mumbai-Maharashtra, India. Approval of Institutional Ethics Committee was taken prior to beginning of the study. Subjects were recruited from the patients attending the medicine outpatient department, antiretro viral therapy center, integrated counseling and testing center and from those admitted in wards. Before proceeding with any kind of test, informed consent was obtained from the subjects. In the case of pediatric patients, consent from the parents was obtained. The study cohort consisted of 192 subjects in two groups; group-1 consisted of 142 HIV sero-positive patients having diarrhea (HIV + D+) and group-2 consisted of 50 HIV sero-negative patients having diarrhea (HIV-D+). Inclusion criteria were diarrhea of >3 days duration. Depending on their HIV sero-status, the subjects were recruited in group-1 and group-2. The patients not having diarrhea and those having diarrhea of ≤3 days were excluded from the study. These patients were from different parts of the Deccan region of India. National AIDS Control Organization, India guidelines were followed for confirmation of HIV status of the study recruits.[3]

MATERIALS AND METHODS

Three early morning stool specimens were collected from each subject over a period of 1-week. Detailed history was taken, and clinical examination was done. The processing and examination of stool specimens were carried out as per standard parasitological techniques without delay.[4-6] The stool specimen in the container was examined macroscopically for consistency; presence of blood or mucus; presence of roundworms; threadworms or tapeworm segments/proglottids; and color and odor of the stool. Microscopic examination of the watery stools was done directly from the specimen. Examination of soft and formed stools was done directly as well as after concentration. The samples were analyzed by light as well as fluorescence microscopy for enteric parasites.

Worm eggs or larvae; and protozoan trophozoites and cysts were detected by saline and iodine wet mount examination. The mounts were examined immediately after preparation under low power (×10) and high power (×40) objectives. Identification of the coccidian parasites-*Cryptosporidium*, *Isospora* and *Cyclospora* was done by doing modified Ziehl-Neelsen's cold staining (Kinyoun's modification of Acid Fast Staining) on dried and fixed smears. The stained slides were examined under low power (×10), high power (×40) and oil immersion (×100) objectives. For the detection of Microsporidia spores modified Trichrome (Chromotrope) staining was done and examination was done under oil immersion (×100) objective.

For the assessment of CD4+ T-lymphocyte count, peripheral venous blood of the patient was collected under strict aseptic precautions in ethylenediaminetetraacetic acid vacutainers. The absolute CD4+ T-lymphocyte counts were done by automated flow-cytometry analyzer (FACS Calibur, Becton Dickinson, New Jersey, USA) and the subjects were categorized as per their immune status.

Statistical analysis

The odds of occurrence of infection by particular microorganism and relative risk in HIV sero-positive group was calculated using SPSS statistics 17.0 software (SPPS, Inc, Chicago, Illinois) by comparing with HIV sero-negative group. The odds of occurrence and relative risk of diarrhea in HIV sero-positive group and sero-negative group were also calculated using SPSS statistics 17.0 software.

RESULTS

In the study population, male gender was predominant with 72% representatives, and only 28% were females. Maximum number of the patients were from age group 31–40 years in group 1 (HIV sero-positive patients having diarrhea), whereas in group 2 (HIV sero-negative patients having diarrhea) maximum patients were having age ≤20 years [Figure 1a].

Of the total 192 stool specimens, in 66 (34.4%), parasites were detected. The parasites detected belonged to 11 different genera including *Isospora belli*, *Cryptosporidium* sp., *Cyclospora cayatenensis*, *Entamoeba histolytica*/*Entamoeba dispar*, *Giardia intestinalis*, *Strongyloides stercoralis*, *Ascaris lumbricoides*, *Trichiuris trichiura*, *Hymenolepis nana*, *Ancylostoma duodenale* and *Taenia* species. Coccidian parasites; *I. belli*, *Cryptosporidium* sp. and *Cyclospora cayatenensis* were detected in 22 (11.5%), 7 (3.6%) and 3 (1.6%) specimens respectively.

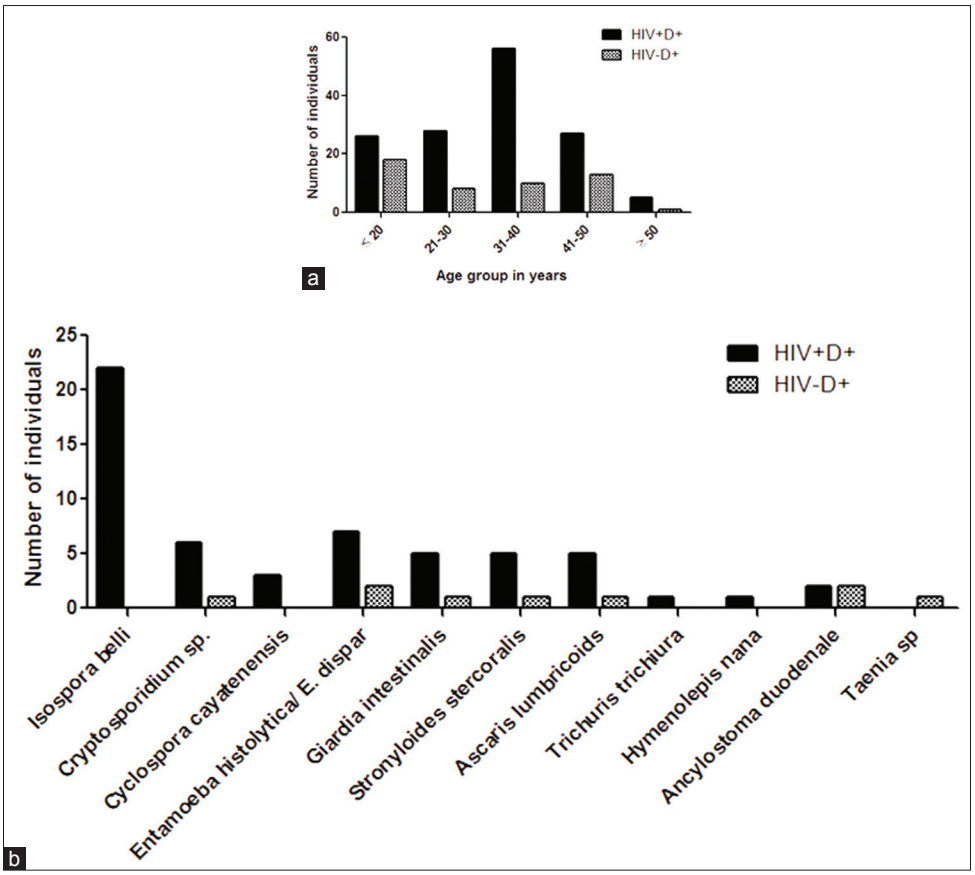

Figure 1: Age and type of enteric parasitic infection in the study population. (a) Number of individuals in different age groups. Maximum patients belonged to age range 31–40 years in HIV sero-positive patients (group-1, *n* = 142), while in HIV sero-negative patients (group-2, *n* = 50)-maximum patients were from age range 21–30 years. (b) Type of enteric parasite causing infection in the two study groups. Group-1 showed significantly higher number of infected patients with *P* < 0.05

Another important intracellular protozoan parasite-Microsporidium, was not detected in any specimen with the method of detection employed.

Extra-cellular protozoa, that is, *E. histolytica*/*E. dispar* and *G. intestinalis* were detected in 9 (4.7%) and 6 (3.1%) specimens, respectively. The helminths detected were - *S. stercoralis* - 6 (4.1%), *A. lumbricoides* - 6 (4.1%), *A. duodenale* - 4 (2.1%), and 1 (0.5%) each of *T. trichiura*, *H. nana* and *Taenia* species. All the coccidian parasites were detected in HIV sero-positive patients, except one *Cryptosporidium* sp. which was detected in an HIV sero-negative child with leukemia. Number of individuals infected with each of these parasites was significantly higher in group-1. In HIV sero-positive subjects having diarrhea, the odds ratio (OR) of parasitic infection were 5.246 with confidence interval (CI) =2.373–11.596 ($P < 0.05$) when compared to HIV negative individuals having diarrhea [Table 1 and Figure 1b]. Mixed parasitic infections were detected in 6 (2.1%) of the subjects from Group-1 (HIV sero-positive patients with diarrhea). No mixed infections were seen in group-2 subjects [Table 2].

The prevalence of parasitic infestation in study Groups-1 and 2 was 35.9% and 18% respectively. In HIV sero-positive patients having diarrhea, the OR of parasitic infection are 5.246 with CI = 2.373–11.596 ($P < 0.05$) when compared with HIV sero-negative individual having diarrhea.

A total of 57 parasites were detected from stool specimens of HIV sero-positive patients (study group-1), of which only 6 (10.5%) were from patients with CD-4 T-lymphocyte counts >500 cells/ml. Rest 51 (89.5%) were from patients with CD-4 T-lymphocyte counts <500 cells/ml. Majority of coccidian parasites, that is, 22 out of 31 (71.0%) were detected from patients with CD4+ T-Lymphocyte counts <200 cells/ml, of which 7 (22.6%) were from patients with CD4+ T-Lymphocyte counts <50 cells/ml ($P < 0.05$, Spearman correlation). 9 (29.0%) coccidian parasites were detected in patients with CD4+ T-Lymphocyte counts between 200 and 500 cells/ml; no coccidian parasites were detected from patients with CD4+ T-Lymphocyte counts higher than 500 cells/ml. 5 out of 6 mixed parasitic infections

Table 1: Different parasites detected in the stool specimens of subjects in the study cohort

Parasites	Total	Group-1	Group-2	Odds ratio	*P*
Protozoa					
Isospora belli	22 (11.5)	22 (11.5)	0	OR=1.183, CI=1.103-1.270	<0.05
Cryptosporidium sp.	7 (3.6)	6 (3.1)	1 (0.5)	OR=2.162, CI=0.254-18.411	NS
Cyclospora cayatenensis	3 (1.6)	3 (1.6)	0	OR=1.022, CI=0.997-1.047	NS
E. histolytica/*E. dispar*	9 (4.7)	7 (3.6)	2 (1)	OR=1.244, CI=0.250-6.198	NS
Giardia intestinalis	6 (3.1)	5 (2.6)	1 (0.5)	OR=1.788, CI=0.204-15.689	NS
Helminths					
Strongyloides stercoralis	6 (3.1)	5 (2.6)	1 (0.5)	OR=1.788, CI=0.204-15.689	NS
Ascaris lumbricoides	6 (3.1)	5 (2.6)	1 (0.5)	OR=1.788, CI=0.204-15.689	NS
Trichiuris trichiura	1 (0.5)	1 (0.5)	0	OR=1.007, CI=0.993-1.021	NS
Hymenolepis nana	1 (0.5)	1 (0.5)	0	OR=1.007, CI=0.993-1.021	NS
Ancylostoma duodenale	4 (2.1)	2 (1)	2 (1)	OR=0.343, CI=0.047-2.501	NS
Taenia species	1 (0.5)	0	1 (0.5)	OR=0.980, CI=0.942-1.020	NS
Total parasites	66 (34.4)	57 (29.7)	9 (4.7)		
Total patients	192 (100)	142 (74)	50 (26)		

Figures in the parentheses indicate percentage. NS=Not significant; OR=Odds ratio; CI=Confidence interval, *E. histolytica=Entamoeba histolytica, E. dispar=Entamoeba dispar, H. nana=Hymenolepis nana*

Table 2: Mixed parasitic infections found in subjects of the study cohort

Parasites	Number of patients	CD4 T-lymphocyte count
E. histolytica/*E. dispar* and *Isospora belli*	1	459 cells/cumm
Giardia intestinalis and *Cryptosporidium* sp.	2	89 and 67 cells/cumm
Strongyloides stercoralis and *Ascaris lumbricoides*	1	85 cells/cumm
Strongyloides stercoralis and *Isospora belli*	1	50 cells/cumm
Ancylostoma duodenale and *Cyclospora cayatenensis*	1	34 cells/cumm
Total	6	

E. histolytica=Entamoeba histolytica, E. dispar=Entamoeba dispar, H. nana=Hymenolepis nana

were seen in patients with CD-4 T-Lymphocyte counts <100 cells/ml [Table 3 and Figure 2a].

77 (54.2%) of the HIV seropositive patients having diarrhea were on HAART. Out of total 57 parasites detected in HIV seropositive patients, 43 (75.4%) were detected in patients who were not on HAART; and 14 (24.6%) were detected in patients who were on HAART. Coccidian parasites, *E. histolytica*/*E. dispar* and *Strongyloides* were detected in significantly low numbers from patients taking HAART [Table 4 and Figure 2b]. The odds of occurrence of infection when the patient is not undergoing HAART therapy were 1.483 with CI = 1.205–1.825 ($P < 0.05$) when compared with patients undergoing HAART therapy.

Of all the 66 symptomatic patients positive for enteric parasites, 62 patients (93.9%) were given the treatment. Of the 4 patients who could not be given treatment, 3 patients expired before the treatment could be started, and the fourth patient was lost to follow-up after submitting stool specimen for examination. Of 62 patients who were prescribed treatment, follow-up could be done in 22 patients. Table 5 shows the details of 22 patients who were available for follow-up. 19 out of 22 patients (86.4%), after treatment, were completely relieved of diarrhea. Follow-up stool specimens of all the 19 patients who were relieved of symptoms were negative for the presence of parasites. The repeat specimens of rest of the 3 patients showed the presence of parasites (*Cryptosporidium* in 2 and *Isospora* in 1 stool specimen).

DISCUSSION

Parasitic diarrheas remain a consistent trouble in PLHA. In the present study, we looked for parasitic etiology in PLHA suffering from diarrhea. The most common parasite detected was *I. belli* in 11.5% of the total population followed by *E. histolytica*/*E. dispar* (4.7%) and *Cryptosporidium* sp. (3.6%). Within helminthes, *S. stercoralis* and *A. lumbricoides* were the most common (3.1%).

Tables 6 and 7 compare the results of our study with similar other studies performed on HIV sero-positive patients with diarrhea in other regions of India and across the world.[7-21] There is a difference in the observed type and frequency of infection in HIV seropositive patients in different regions and time frames. The probable reasons for this discrepancy could be (i) difference in the type of diagnostic test employed as different techniques have variable sensitivity, specificity

Table 3: Correlation of presence of parasites with the CD-4 T-lymphocyte counts of the subjects in the study cohort group-1 (HIV+D+, *n*=142)

Parasites	CD4 T-lymphocyte count in cells/ml						Total
	<50	50-100	101-200	201-350	351-500	>500	
Protozoa							
Isospora	4 (7)	2 (3.5)	8 (14)	5 (8.8)	3 (5.3)	0	22 (38.6)
Cryptosporidium	3 (5.3)	2 (3.5)	1 (1.8)	0	0	0	6 (10.5)
Cyclospora	0	1 (1.8)	1 (1.8)	0	1 (1.8)	0	3 (5.3)
E. histolytica/E. dispar	1 (1.8)	0	1 (1.8)	3 (5.3)	1 (1.8)	1 (1.8)	7 (12.3)
Giardia	1 (1.8)	0	1 (1.8)	2 (3.5)	1 (1.8)	0	5 (8.8)
Helminths							
Strongyloides	1 (1.8)	1 (1.8)	2 (3.5)	1 (1.8)	0	0	5 (8.8)
Ascaris	0	0	0	1 (1.8)	1 (1.8)	3 (5.3)	5 (8.8)
Trichiuris	0	0	0	0	1 (1.8)	0	1 (1.8)
H. nana	0	0	0	0	0	1 (1.8)	1 (1.8)
Ancylostoma	0	0	0	0	1 (1.8)	1 (1.8)	2 (3.5)
Total parasites	10 (17.5)	6 (10.5)	14 (24.6)	12 (21.1)	9 (15.8)	6 (10.5)	57 (100)

Figures in the parentheses indicate percentage. *E. histolytica=Entamoeba histolytica, E. dispar=Entamoeba dispar, H. nana=Hymenolepis nana*

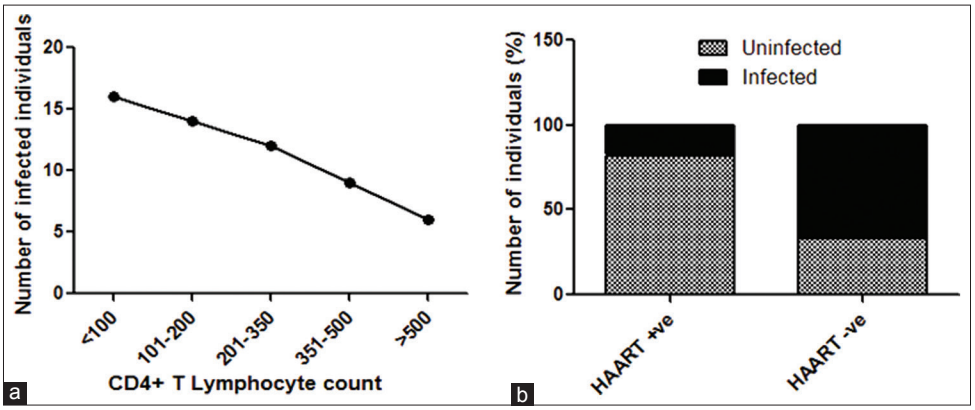

Figure 2: Co-relation of presence of parasites with immunological status and highly active anti retro-viral therapy (HAART) in study group-1 (HIV + D+, *n* = 142). (a) Correlation between number of infected individuals and CD4+ T-lymphocyte counts. A negative correlation was observed between infected patients and CD4+ counts. (b) Distribution of the enteric parasites in the subjects on HAART and those who are not on HAART. The subjects taking HAART showed significantly lower number of parasitic infections than those not taking HAART (*P* < 0.05)

and predictive values (ii) variation in the infecting organism due to geographical region or (iii) change in the type and frequency of infection over the period of time.

Various authors have reported prevalence of microsporidia in the range of 0–18% in their studies.[7-11] In the present study, however, with the method of detection employed, spores of microsporidia were not detected in any of the 192 stool specimens. As only light microscopy was performed, a negative result did not rule out the possibility of microsporidial infection. The reason being that spores of microsporidia are very small (1–4 μ), and can be perplexed with bacteria, bacterial spores or fungal spores. Transmission Electron Microscopy or molecular methods are the method of choice for diagnosis of Microsporidial infection. Light microscopy therefore has proven to be an insensitive technique for detection of microsporidial spores, at least in our study.

In the present study, the prevalence of enteric parasites in the two study groups was 35.9% in group-1 and 18% in group-3. Statistically, the difference between the prevalence of opportunistic parasitic infections in different study groups was found to be significant. These results co-relate well with those of Kumar *et al.*, Ramakrishnan *et al.*, Cimerman *et al.* and Sapkota *et al.*[9,12-14]

Opportunistic infections occur as a result of the organisms taking advantage of the opportunity offered by a weakened immune system of the host. CD-4+ T-lymphocytes are the indicators of immune status of the host. OIs, therefore, tend to occur in patients with decreased CD-4+ T-lymphocyte counts. In the present study, only 10.5% of the total parasites detected in HIV sero-positive patients were from patients with CD-4+ T-lymphocyte counts >500 cells/ml. Rest of the 89.5% were from patients with CD-4+ T-lymphocyte

counts <500 cells/ml. Majority of coccidian parasites were detected in patients with CD-4+ T-lymphocyte counts <200 cells/ml. Statistically, a negative correlation was observed between opportunistic parasitic infections and the CD4+ T-lymphocyte counts of the patients. All mixed parasitic infections, but one were seen in patients with CD-4+ T-lymphocyte counts <100 cells/ml. 1 mixed infection was seen in a patient with CD4+ T-lymphocyte counts 459 cells/ml.

Table 4: Distribution of the enteric parasites in the subjects on HAART and those who are not on HAART in the study cohort group-1 (HIV+D+, *n*=142)

Parasites	HAART+	HAART−	Total
Protozoa			
Isospora	4 (7.0)	18 (31.6)	22 (38.6)
Cryptosporidium	1 (1.8)	5 (8.8)	6 (10.5)
Cyclospora	0	3 (5.3)	3 (5.3)
E. histolytica/E. dispar	3 (5.3)	4 (7.0)	7 (12.3)
Giardia	2 (3.5)	3 (5.3)	5 (8.8)
Helminths			
Strongyloides	1 (1.8)	4 (7.0)	5 (8.8)
Ascaris	2 (3.5)	3 (5.3)	5 (8.8)
Trichiuris	0	1 (1.8)	1 (1.8)
H. nana	0	1 (1.8)	1 (1.8)
Ancylostoma	1 (1.8)	1 (1.8)	2 (3.5)
Total parasites	14 (24.6)	43 (75.4)	57 (100)

Figures in the parentheses indicate percentage. HAART=Highly active anti retro-viral therapy, *E. histolytica=Entamoeba histolytica, E. dispar=Entamoeba dispar, H. nana=Hymenolepis nana*

About 54.2% of the HIV sero-positive patients in the study population were on HAART. Out of total 57 parasites detected in HIV sero-positive patients, only 24.6% were detected in patients who were on HAART, and 75.4% were detected in patients who were not on HAART. The combination therapy decreases the viral load and boosts the immune system; accordingly, in the present study, prevalence of opportunistic enteric parasites was considerably low in patients on HAART, when compared to those not taking HAART.

As definite treatment is available for all the opportunistic parasites except *Cryptosporidium* sp., treatment was started immediately after diagnosis in all but 4 patients (93.9%). On follow-up, 86.4% were cured of symptoms and infestation.

Table 5: Details of 22 patients who were available for follow-up

HIV sero-status	Age (years)/ sex	Diarrhea-episodes, duration	Parasite detected	Treatment given	Examination of follow-up sample
Positive	40/male	8-10/day, 10 days	*Cyclospora cayatenensis*	Trimethoprim/sulphsmetoxazole	No parasite detected
Positive	45/female	8-10/day, 2 months	*Isospora belli*	Trimethoprim/sulphsmetoxazole	No parasite detected
Positive	25/male	5-6/day, >1-month	*Hymenolepis nana*	Praziquantal	No parasite detected
Positive	36/female	4-5/day, 1-month	*Isospora belli*	Trimethoprim/sulphsmetoxazole	No parasite detected
Positive	32/female	5-6/day, 20 days	*Entamoeba histolytica*	Metronidazole followed by iodoquinol	No parasite detected
Positive	28/male	6-8/day, 14 days	*Strongyloides stercoralis*	Ivermectin	No parasite detected
Positive	52/female	3-5/day, 20 days	*Entamoeba histolytica*	Metronidazole	No parasite detected
Positive	2/female	4-5/day, 1-month	*Giardia intestinalis and Cryptosporidium* sp.	Moetronidazole and nitazoxanide	*Giardia* not deetcetd but oocysts of *Cryptosporidium* detected
Positive	38/male	6-8/day, >1-month	*Entamoeba histolytica*	Metronidazole followed by iodoquinol	No parasite detected
Positive	10 months/ male	3-4/day, 25 days	*Cryptosporidium* sp.	Nitazoxanide	Oocysts of *Cryptosporidium* detected
Positive	17/female	4-5/day, 2 months	*Giardia intestinalis*	Metronidazole	No parasite detected
Positive	29/male	3-6/day, 2 months	*Trichiuris trichiura*	Mebendazole	No parasite detected
Positive	10/male	3-4/day, on and off for 6 months	*Ascaris lumbricoides*	Albendazole	No parasite detected
Positive	32/female	4-5/day, 25 days	*Entamoeba histolytica*	Metronidazole	No parasite detected
Positive	22/female	6-8/day, 20 days	*Isospora belli*	Trimethoprim/sulphsmetoxazole	Oocysts of *Isospora* detected
Positive	48/male	5-6/day, 10 days	*Isospora belli*	Trimethoprim/sulphsmetoxazole	No parasite detected
Positive	59/male	4-5/day, 3 months	*Strongyloides stercoralis*	Ivermectin	No parasite detected
Positive	26/female	5-6/day, 14 days	*Isospora belli*	Trimethoprim/sulphsmetoxazole	No parasite detected
Negative	45/female	3-4/day, >1-month	*Taenia* sp.	Niclosamide	No parasite detected
Negative	4/male	4-5/day, 5 days	*Cryptosporidium* sp.	Nitazoxanide	No parasite detected
Negative	24/male	5-6/day, 1-month	*Strongyloides stercoralis*	Thiabendazole	No parasite detected
Negative	7/male	3-5/day, 12 days	*Entamoeba histolytica*	Metronidazole followed by iodoquinol	No parasite detected

Table 6: Comparison with similar studies from India

Authors	Place	Year	Sample size (stool specimens of PLHA with diarrhea)	Prevalence	*Isospora*	*Cyclospora*	*Cryptosporidium*	Microsporidium	*Giardia*	*E. histolytica*/ *E. dispar*	*Strongyloides*
Lanjewar *et al.*	Mumbai, India	1994	89	(32.1)	(4.5)	-	(20.9)	-	-	-	(6.7)
Anand *et al.*	Imphal, India	1997	196	(61.2)	(6.6)	(4.5)	(40.3)	-	-	(3.4)	-
Talib *et al.*	Aurangabad, India	1998	80	(13.8)	(1.3)	-	(6.3)	-	(2.5)	2.5	-
Mukhopadhya *et al.*	Vellore, India	1999	111	(48.7)	(11.7)	-	(8.1)	(5.4)	(15.3)	(0.9)	(6.3)
Kumar *et al.*	Chennai, India	2002	150	(26.5)	(12.9)	-	(9.3)	(1.7)	-	-	-
Joshi *et al.*	Mumbai, India	2003	94	(56.4)	(17)	-	(8.5)	-	(4.3)	(14.9)	(5.3)
Dalvi *et al.*	Mumbai, India	2006	64	(54.7)	(18.7)	-	(3.1)	(17.2)	-	-	-
Kuppamuthu *et al.*	Chennai, India	2007	80	(38.7)	(1.2)	-	(28.7)	-	(3.7)	(17.5)	-
Present study	Mumbai, India	2008	142	(35.9)	(15.5)	(2.1)	(4.2)	-	(3.5)	(4.9)	(3.5)

Figures in the parentheses indicate percentage. PLHA=People living with HIV/AIDS, *E. histolytica=Entamoeba histolytica*, *E. dispar=Entamoeba dispar*

Table 7: Other similar studies across the world

Authors	Place	Year	Sample size (stool specimens of PLHA with diarrhea)	*Prevalence*	*Isospora*	*Cyclospora*	*Cryptosporidium*	Microsporidium	*Giardia*	*E. histolytica*/ *E. dispar*	*Strongyloides*
Lindo *et al.*	Honduros	1998	52	(49)	-	-	(7.7)	-	(1.9)	(5.8)	(7.7)
Cimerman *et al.*	Brazil	1999	200	(40)	(2)	-	(7)	-	(16)	(13)	(2.5)
Wiwanitkit *et al.*	Thailand	2001	60	(50)	(5)	(1.7)	(3.3)	(1.67)	-	-	-
Zali *et al.*	Iran	2004	206	(18.4)	-	-	(1.5)	-	(7.3)	(3.9)	(1)
Sapkota *et al.*	Nepal	2004	75	(32)	-	(1.9)	(10.7)	-	(6.7)	(5.3)	(2.7)
Sarfati *et al.*	Cameroon	2006	154	(9.7)	(1)	(1.2)	(2)	(2.7)	(0.3)	(2.1)	(1.7)
Meamar *et al.*	Iran	2007	191	(11.4)	(0.3)	(2.7)	(0.9)	-	(4.2)	-	(0.3)

Figures in the parentheses indicate percentage. PLHA=People living with HIV/AIDS, *E. histolytica=Entamoeba histolytica*, *E. dispar=Entamoeba dispar*

Thus, our study has added to the literature of opportunistic intestinal parasites in PLHA. We have also looked into the difference in parasitic incidence in patients taking and not taking HAART. The role of early diagnosis and timely specific treatment has been highlighted with the results of follow-up of the treated patients. The major limitation of the study is that the subjects were recruited consecutively, and proper randomization was not done. Furthermore, the number of patients who turned up for follow-up was far less than the numbers treated, which if had been foreseen-could be reduced by doing proper counseling in this regard and emphasizing the importance of long-term follow-up in such cases.

In order to have proper management of HIV-infected individuals in place, in a developing country like India, population-based data on different OIs comprising different regions needs to be embarked on. Our study adds recent information on the type of enteric parasitic infections in HIV patients from Deccan region. A compilation of more such observations from different regions and different OIs could provide a clearer picture and interpretation of the scientific findings may help in perceiving extent of OIs in the PLHA, which may in turn lead to development of sustainable management programs.

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